**IN THE CLAIMS:**

1. (Previously Presented) A wavelength division multiplexing optical transmission system, comprising:

a plurality of optical senders outputting signal lights with different wavelengths and filtered by a plurality of respective filters to yield filtered signal lights having respective bit rates and frequency spacing to approach a spectrum efficiency maximizing a product of a transmission distance and a transmission capacity of the system;

an optical multiplexer multiplexing the filtered signal lights to be transmitted to an optical transmission path as a wavelength division multiplexing signal light; and

an optical demultiplexer demultiplexing the wavelength division multiplexing signal light having different respective wavelengths to be received by a plurality of optical receivers,

wherein the type of modulation of said signal light is determined to be an NRZ modulation type, and

wherein an equation model expressing transmission characteristics of said optical multiplexer and said optical demultiplexer is expressed by the following equation in which each transmission band T(f) corresponding to each signal light is expressed by using a frequency f, where fc is a center frequency of the transmission band, and Δf is a full width at half maximum of the transmission band, as a filter order "n"

$$T(f) = 10 \cdot \log\left[\exp\left\{-2 \cdot \ln\sqrt{2} \cdot \left(\frac{|f - fc|}{\Delta f/2}\right)^{2n}\right\}\right] \quad (dB)$$

2. (Canceled).

3. (Previously Presented) A wavelength division multiplexing optical transmission system according to claim 1,

wherein said filter order "n" is secondary, and the spectrum efficiency at which the product of said transmission distance and said transmission capacity becomes the maximum value is 0.574bit/s/Hz.

4. (Original) A wavelength division multiplexing optical transmission system according to claim 3,

wherein, when the bit rate B and frequency grid I per one wave of the signal light are given in advance, a natural number "k" is selected so as to minimize a difference between the spectrum efficiency B/(kI) where "k" is the natural number, and the spectrum efficiency at which the product of said transmission distance and said transmission capacity becomes the maximum value, so that frequency spacing S=kI, of the signal light is set in accordance with the natural number "k".

5. (Original) A wavelength division multiplexing optical transmission system according to claim 4,

wherein, when a value B/I obtained by dividing said bit rate B by said frequency grid I is 1.6 to 2.0bit/s/Hz, 3 is selected as said natural number "k".

6. (Original) A wavelength division multiplexing optical transmission system according to claim 5,

wherein, when 40 to 50Gbit/s is given as said bit rate B, and 25GHz interval is given as said frequency grid I, frequency spacing is set to 75GHz.

7. (Original) A wavelength division multiplexing optical transmission system according to claim 4,

wherein, when a value B/I obtained by dividing said bit rate B by said frequency grid I is 1.6bit/s/Hz, and 3 is selected as said natural number "k",

said optical multiplexer and said optical demultiplexer have transmission characteristics following said equation model in which said filter order "n" is 1.2 or more.

8. (Original) A wavelength division multiplexing optical transmission system according to claim 7,

wherein said optical multiplexer and said optical demultiplexer have transmission characteristics in which a value Δf/fb obtained by dividing full width at half maximum Δf of said transmission band by a clock frequency fb of the signal light, is within a range of 1.50 to 1.90.

9. (Original) A wavelength division multiplexing optical transmission system according to claim 4,

wherein, when a value B/I obtained by dividing said bit rate B by said frequency grid I is 1.7bit/s/Hz, and 3 is selected as said natural number "k",

said optical multiplexer and said optical demultiplexer have transmission characteristics following said equation model in which said filter order "n" is 1.5 or more.

10. (Original) A wavelength division multiplexing optical transmission system according to claim 9,

wherein said optical multiplexer and said optical demultiplexer have transmission characteristics in which a value Δf/fb obtained by dividing full width at half maximum Δf of said transmission band by a clock frequency fb of the signal light, is within a range of 1.45 to 1.95.

11. (Original) A wavelength division multiplexing optical transmission system according to claim 4,

wherein, when a value B/I obtained by dividing said bit rate B by said frequency grid I is 2.0bit/s/Hz, and 3 is selected as said natural number "k",

said optical multiplexer and said optical demultiplexer have transmission characteristics following said equation model in which said filter order "n" is 2 or more.

12. (Original) A wavelength division multiplexing optical transmission system according to claim 11,

wherein said optical multiplexer and said optical demultiplexer have transmission characteristics in which a value Δf/fb obtained by dividing full width at half maximum Δf of said transmission band by a clock frequency fb of the signal light, is within a range of 1.35 to 1.70.

13. (Original) A wavelength division multiplexing optical transmission system according to claim 1,

wherein each of said optical multiplexer and said optical demultiplexer is constituted using an arrayed waveguide grating.

14. (Original) A wavelength division multiplexing optical transmission system according to claim 1,

wherein each of said optical multiplexer and said optical demultiplexer is constituted by combining an optical interleaver using an interference filter, and an arrayed waveguide grating.

15. (Original) A wavelength division multiplexing optical transmission system according to claim 1,

wherein each of said optical multiplexer and said optical demultiplexer is constituted by combining an optical interleaver using an interference filter, and a dielectric multi-layer film filter.

16. (Original) A wavelength division multiplexing optical transmission system according to claim 1,

wherein the spectrum efficiency at which the product of said transmission distance and said transmission capacity becomes the maximum value is calculated as spectrum efficiency at which a performance index PI=10 · (-ΔQ/10) · B/S, which is expressed using a Q-value degradation amount ΔQ of the system, a bit rate B and frequency spacing S of the signal light, becomes a maximum value.

17. (Previously Presented) A wavelength division multiplexing optical transmission method, comprising:

multiplexing a plurality of signal lights with different wavelengths to transmit to an optical transmission path; and

demultiplexing wavelength division multiplexed signal light propagated through said optical transmission path according to wavelength to receive,

wherein the type modulation of said signal light is determined to be an NRZ modulation type, and

wherein an equation model expressing transmission characteristics of said optical multiplexer and said optical demultiplexer is expressed by the following equation in which the shape of each transmission band T(f) corresponding to each signal light is expressed by as a function of frequency f, wherein fc is a center frequency of the transmission band, and Δf is a full width at half maximum of the transmission band, and a filter order "n",

$$T(f) = 10 \cdot \log\left[\exp\left\{-2 \cdot \ln\sqrt{2} \cdot \left(\frac{|f - fc|}{\Delta f/2}\right)^{2n}\right\}\right] \quad (dB)$$

wherein a bit rate and frequency spacing of the signal lights are set so as to approach a spectrum efficiency at which a product of a transmission distance and a transmission capacity becomes maximum, and actual transmission characteristics at the time of multiplexing and demultiplexing the signal light are set in accordance with said equation model, to transmit the wavelength division multiplexed signal light.

18. (Previously Presented) A wavelength multiplexing apparatus for multiplexing optical signals with a plurality of wavelengths, comprising:

a polarization independent filter narrowing a transmission bandwidth of the multiplexed signals,

wherein the type of modulation of said signal light is determined to be an NRZ modulation type,

wherein said polarization independent filter has transmission characteristics in which a transmission bandwidth is set in accordance with an equation model expressed by the following equation in which each transmission band T(f) corresponding to each signal light is expressed as a function of a frequency f, fc being the center frequency of the transmission band, and Δf being a full width at half maximum of the transmission band,

$$T(f) = 10 \cdot \log\left[\exp\left\{-2 \cdot \ln\sqrt{2} \cdot \left(\frac{|f - fc|}{\Delta f/2}\right)^{2n}\right\}\right] \quad \text{(dB)}$$

, and

wherein each component on a short wavelength side and a long wavelength side of each of said optical signals of the plurality of wavelengths is eliminated by said polarization independent filter, thereby generating a wavelength division multiplexed light in which spacing of said optical signals is made narrower than an initial spectrum width to be output .

19. (Canceled).

20. (Previously Presented) A wavelength demultiplexing apparatus for demultiplexing wavelength division multiplexed light obtained by multiplexing optical signals with a plurality of wavelengths, comprising:

a polarization independent filter narrowing a bandwidth of a spectrum,

wherein the type of modulation of said signal light is determined to be an NRZ modulation type,

wherein said polarization independent filter has transmission characteristics in which a transmission bandwidth is set in accordance with an equation model expressed by the following equation in which each transmission band T(f) corresponding to a signal light is expressed as a function of a frequency f, fc being a center frequency of the transmission band, and Δf being a full width at half maximum of the transmission band, and a filter order "n",

$$T(f) = 10 \cdot \log\left[\exp\left\{-2 \cdot \ln\sqrt{2} \cdot \left(\frac{|f - fc|}{\Delta f/2}\right)^{2n}\right\}\right] \quad (dB)$$

, and

wherein each component on a short wavelength side and a long wavelength side of each of said optical signals is eliminated by said polarization independent filter, thereby optical signals with a plurality of wavelengths in which spacing of said optical signals is made narrower than an initial spectrum width to be output.

21. (Canceled).

22. (Previously Presented) An optical transmission system including a wavelength multiplexing apparatus for multiplexing optical signals with a plurality of wavelengths, and a wavelength demultiplexing apparatus for demultiplexing wavelength division multiplexed light obtained by multiplexing optical signals with a plurality of wavelengths, wherein each wavelength multiplexing apparatus and wavelength demultiplexing apparatus comprise:

a polarization independent filter narrowing a transmission bandwidth of the optical signals in the wavelength division multiplexed light,

wherein the type of modulation of said signal light is determined to be an NRZ modulation type,

wherein said polarization independent filter has transmission characteristics in which a transmission bandwidth is set in accordance with an equation model expressed by the following equation in which each transmission band T(f) corresponding to a signal light is expressed as a function of a frequency f, fc being a center frequency of the transmission band, and Δf being full width at half maximum of the transmission band, and a filter order "n",

$$T(f) = 10 \cdot \log\left[\exp\left\{-2 \cdot \ln\sqrt{2} \cdot \left(\frac{|f - fc|}{\Delta f/2}\right)^{2n}\right\}\right] \quad (dB)$$

, and

wherein each component on a short wavelength side and a long wavelength side of each of said optical signals of the plurality of wavelengths is eliminated by said polarization independent filter, thereby, in said wavelength multiplexing apparatus, generating a wavelength division multiplexed light in which spacing of said optical signals is made narrower than an initial spectrum width to be output, and in said wavelength demultiplexing apparatus, demultiplexing the optical signals with the plurality of wavelengths in which spacing of said optical signals is made narrower than said initial spectrum width to be output.

23-24. (Canceled).

25. (Previously Presented) A method of transmitting multiplexed light signals with different wavelengths through an optical fiber, comprising:

optimizing a transmission characteristic corresponding to each light signal by superimposing a gaussian filter centered on a frequency of each light signal, which narrows a bandwidth of the light signal before multiplexing the light signals,

wherein the type of modulation of said signal light is determined to be an NRZ modulation type, and

wherein said gaussian filter has transmission characteristics in which transmission bandwidth is set in accordance with an equation model expressed by the following equation in which each transmission band T(f) corresponding to a signal light is expressed as a function of a frequency f, fc being a center frequency of the transmission band, and Δf being a full width at half maximum of the transmission band, and a filter order "n",

$$T(f) = 10 \cdot \log\left[\exp\left\{-2 \cdot \ln\sqrt{2} \cdot \left(\frac{|f - fc|}{\Delta f/2}\right)^{2n}\right\}\right] \quad (dB).$$